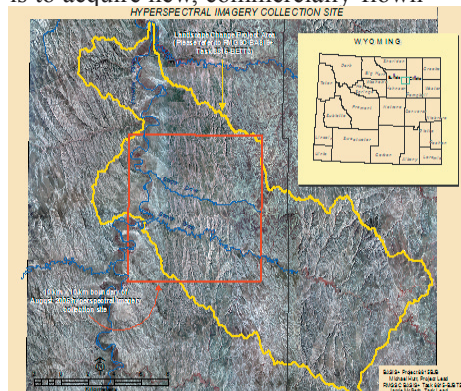


Rocky Mountain Geographic Science Center

Coalbed Methane Extraction and Soil Suitability Concerns in the Powder River Basin, MT and WY

Coalbed Methane Extraction

Extraction of methane gas from coal beds produces large volumes of water ("co-produced water"). Roughly 200 Bbl/day/well of water are being extracted from wells in the Powder River Basin (PRB), most of it from the Wyoming portion of the Basin. This water must be disposed of or put to beneficial use. Common water management strategies are to discharge the water into drainages, stock ponds, or infiltration ponds, or to apply the water directly to the land surface via irrigation equipment or atomizers. Resource and land managers need data on the suitability of soils in the PRB for direct application of sodium-dominated co-produced waters. It is important to avoid application onto soils containing swelling clays (smectites) because these are the soils susceptible to damage from sodic water. The objective of this portion of the task is to acquire new, commercially-flown



hyperspectral data for purposes of clay mapping and soils characterization over a 100 km² area that is a subset of the interdisciplinary DOI CBM Science on the Landscape Initiatives project area (RMGSC BASIS+ Task 8815-BETT3). The area was chosen in coordination with other team members and collaborators from BLM. The area includes (a) sites where CBM water is currently being applied to land surfaces in the forms of spraying, field irrigation, or channel discharge; and (b) areas where there is

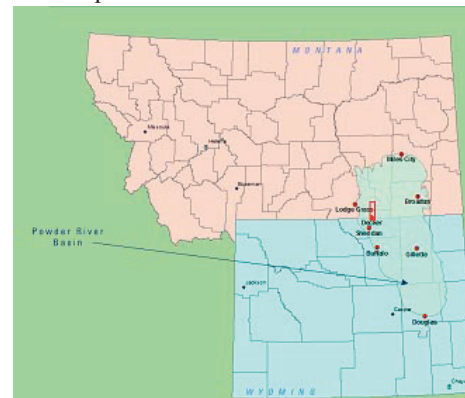
no current water application, for baseline data acquisition purposes. Although expensive, remotely-sensed hyperspectral data may be a cost-effective tool to predict effects of coalbed methane water management strategies in the PRB and other semi-arid lands.

Powder River Basin Water Quality

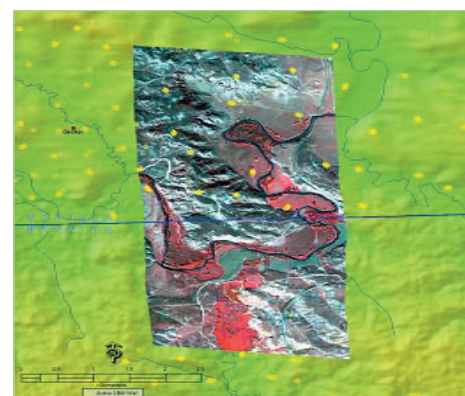
Suitability of irrigation water is of great concern in the Powder River Basin (PRB), especially as coalbed methane (CBM) development pushes farther north into Montana. Preliminary chemistry results from CBM-produced water in Wyoming indicate that sodium is the dominant cation and that sodium adsorption ratio (SAR) values increase toward the western and northern portions of the basin. SAR is a measure of the exchangeable sodium in water or soil as compared to calcium and magnesium. A soil's infiltration rate decreases as the SAR increases, and the soil becomes almost impermeable to rain or irrigation water. Fine-grained soils high in clay are more susceptible to damage from irrigation water with elevated SAR values. Montmorillonite clays are especially susceptible to damage due to their high swelling capacity. Specifically, sodium montmorillonite is characterized by a higher swelling capacity and lower permeability than calcium montmorillonite, but calcium montmorillonite is more susceptible to sodium replacement of calcium or magnesium. Irrigators who are using water from the Tongue and Powder River drainages are concerned about how the degraded quality of the CBM-produced water will affect their soil, and by extension their crops. Knowledge of the spatial distribution of clayey soils is important in determining soil irrigation suitability, but perhaps even more significant is the need to know the type of clay in the soil.

The objective of this portion of the task is to complete the processing and analysis of airborne hyperspectral data flown in October 2001 by ESSI near Decker,

Montana. This proof of concept will determine if hyperspectral data from this time of year are sufficient to characterize the surficial soils and mineralogy in this portion of the PRB. Where feasible, clay minerals will be identified and mapped. Abundant montmorillonite clay will indicate those areas where the soil is susceptible to damage from high-sodium irrigation water. Clay mineral distribution maps and a soil irrigation suitability map will be produced.



Location map of Montana hyperspectral flightline (red box above).



Detailed look at the southern portion of the line near Decker, Montana and the Tongue River, which is an area of coalbed methane activity.

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